Volume 27 December, 1941 *Number 12*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Modern Packaging Machinery

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS

FOR

MODERN PACKAGING MACHINERY

BEARINGS—SLEEVE TYPE

Ring, Chain or Collar Oiled	Texaco Cetus Oil or Alcaid Oil, or Texaco Canopus Oil or Canopus Oil D
Grease Lubricated	Texaco Summitlubes or Texaco Star Grease No. OO or No. 1

BEARINGS—BALL OR ROLLER

According to Speed, Temperature and Seal	Texaco Starfak Grease No. OO, No. 2 or No. 3

CHAINS

Drip or Sight Feed Lubricated	Texaco Alcaid Oil or Algol Oil
Bath Lubricated	Texaco Cetus Oil or Alcaid Oil, or Texaco Canopus Oil or Canopus Oil D

GEARS

Oil Lubricated	Texaco Alcaid Oil or Canopus Oil D
Grease Lubricated	Texaco No. 919 Lubricant "S" or Texaco Star Grease No. 1

CAMS

Texaco No. 919 Lubricant "S" or Texaco Star Grease No. 1

LUBRICATION

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Published by

The Texas Company, 135 East 42nd Street, New York City

Vol. XXVII December, 1941 No. 12

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Lubrication of Modern Packaging Machinery

WHENEVER machinery is required to function with extreme accuracy, the component parts must be designed to an equally accurate degree in order that they will all work together with complete unity. This requires most careful consideration of tolerances or allowable leeway in size. Tolerances have a direct relationship to lubrication where bearings, gears, cams or chains are involved; a relationship which increases with the intricacy of the machine.

Modern packaging machinery is of this type. It performs a wide variety of intricate functions, on products, and in such a manner that any variation in the operation of any of the machine parts might seriously disrupt a production schedule. Wear must be prevented; should it occur to any extent, the synchronism of the machinery might be disturbed to such a degree as to require immediate renewal of the parts involved.

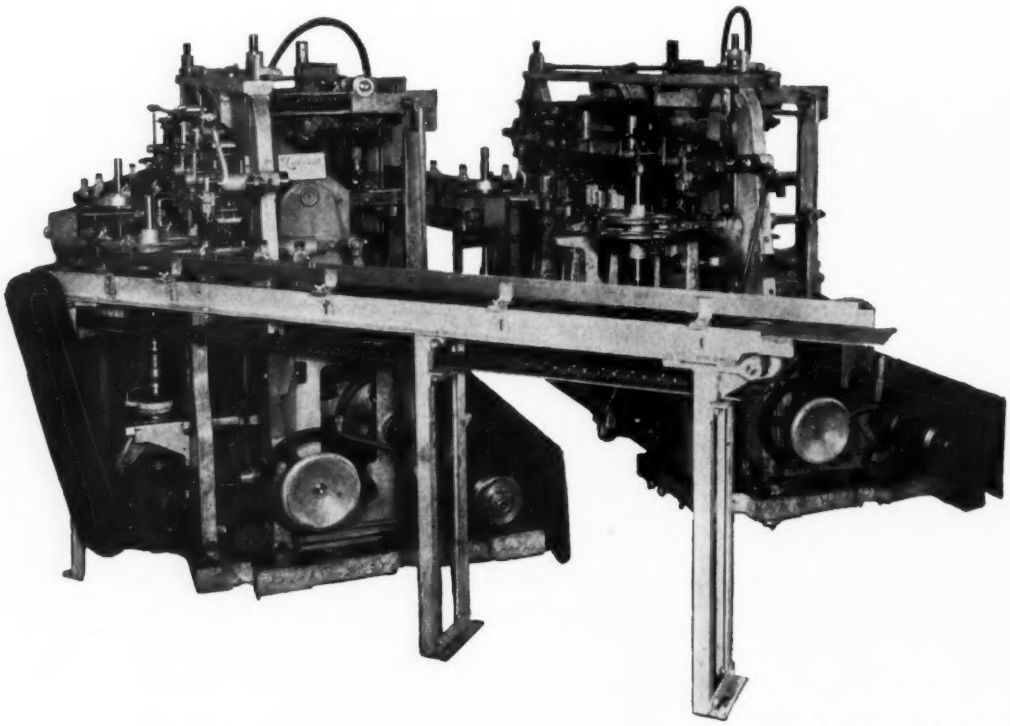
Effective lubrication can be attained provided only that the controlling factors are thoroughly understood. These include the operating conditions, and the design and construction of the equipment involved. Since these factors may vary it is impracticable to state that for any particular type of equipment a lubricant of certain definite characteristics should always be used. Consideration should first be given to the speed of operation, the prevailing operating temperatures, the extent to which pressure may be developed between the moving parts, the means provided for lubricant circulation or re-lubrication and the extent to which contamination or loss of lubricant may develop due to exposure or inadequate housing of the mechanisms.

Packaging machinery is designed for the protection of the materials being handled; automatically this implies protection of the lubricants and but little possibility of contamination. Many of the mechanisms, however, are intricate; they will require but little lubrication, but this must be controlled as speed and temperature conditions may vary quite widely.

FUNCTION OF THE DESIGNING ENGINEER

These factors are normally taken into consideration by the designing engineer from the very first drafting room lay-out. If it is impossible to prevent some types of packaging machines from coming in contact with abrasive foreign matter, he may be justified in not giving it the same care as he would to a device which can be installed apart from dust or dirt, and the detrimental effects of humidity or wide temperature variations. It is perfectly practicable, however, to design certain types of machinery, in such a dust tight manner as to absolutely insure maintenance of quite as effective lubrication as can be secured where these conditions do not exist. This has been materially aided by the development of the ball and roller bearing and the success achieved by the builders of such bearings in constructing dust guards and means of lubricant retention.

Design is a criterion as to the degree of refinement essential in a lubricant. In packaging machine service, it may be presumed that highly refined lubricants are always advisable. Specific usage will control specific characteristics, which may be embodied in a general lubrication recommendation when the designing engineer has completed his assignment. Even so such a recommendation is more or less of an ideal, for it is based upon modern design and the assumption that the builders realize the importance of lubrication and the necessity for protecting the moving parts as much as possible.



Courtesy of New Jersey Machine Corp.

Fig. 1—Closeup of a high speed labeling machine with guards to show the bearings, sliding parts and other moving elements.

On the other hand, whereas a very high grade of grease or a filtered straight mineral oil would be adaptable to such a type of design, where an older installation is involved it may be necessary to substitute a product which from a price point of view will be in line with the existing conditions.

It is for this reason that a working lubrication recommendation should normally include two or more grades of lubricants of varying degree of refinement; where oils are involved, however, they should be of approximately the same viscosity, commensurate with the speed, operating pressure, and the extent to which temperature variation may occur.

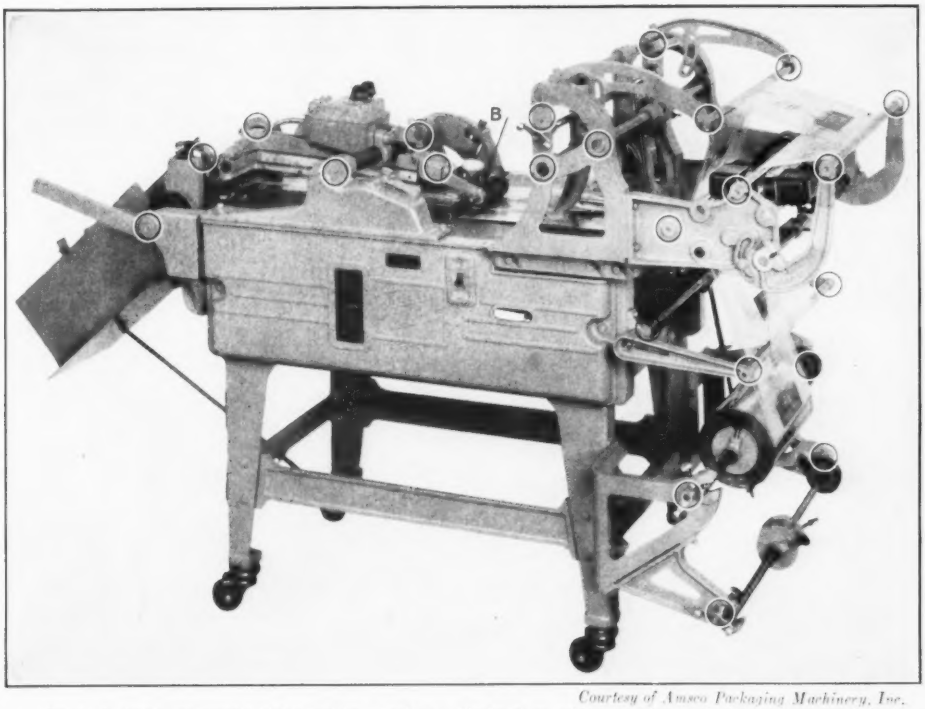
The operator should, in turn, realize this when in the market for such lubricants. If he is dealing with a representative of a reputable oil company these facts will be brought to his attention, the proper viscosity or body of the lubricant decided upon, and the choice between a primary and secondary grade of lubricant justified according to the operating conditions of the installation.

A thorough understanding of operating conditions including speed, pressure, temperature and the possibility of water coming in contact with wearing parts, or the extent to which contaminating foreign matter may be prevalent, is always essential if an intelligent lubrication recommendation is to be made.

As a general rule, speed and pressure must be regarded as inter-related, especially in the choice of body of an oil or the consistency of a grease.

SPEED

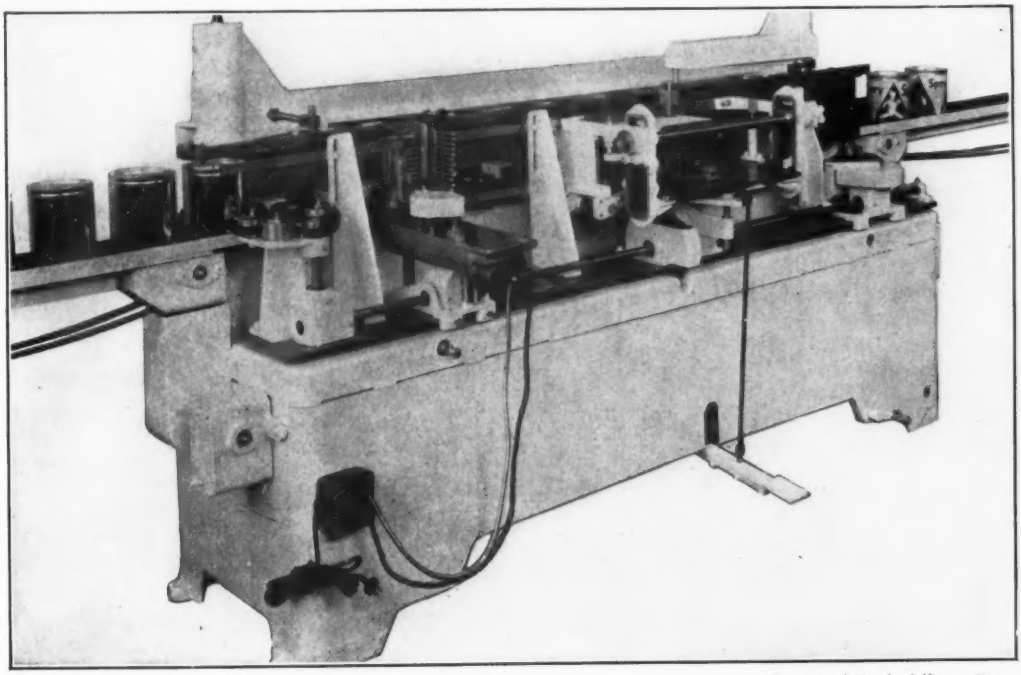
In selecting lubricating oils for bearing service, where speed alone is considered, it will generally be practicable to vary the viscosity inversely with the speed. In other words, for high speed conditions a comparatively light bodied lubricant can be used. Lower speeds will require a heavier product.



Courtesy of Amsco Packaging Machinery, Inc.

Fig. 2—A simplex automatic high speed bag machine. Circles show points requiring lubrication. Note particularly (b) the oil hole in the top for internal cam lubrication.

The reason for this is that the higher the speed the greater will be the degree to which the lubricant will be drawn into the clearance spaces by capillary action. The development of a constant film of lubricant within the bearing clearance space, however, will of course be



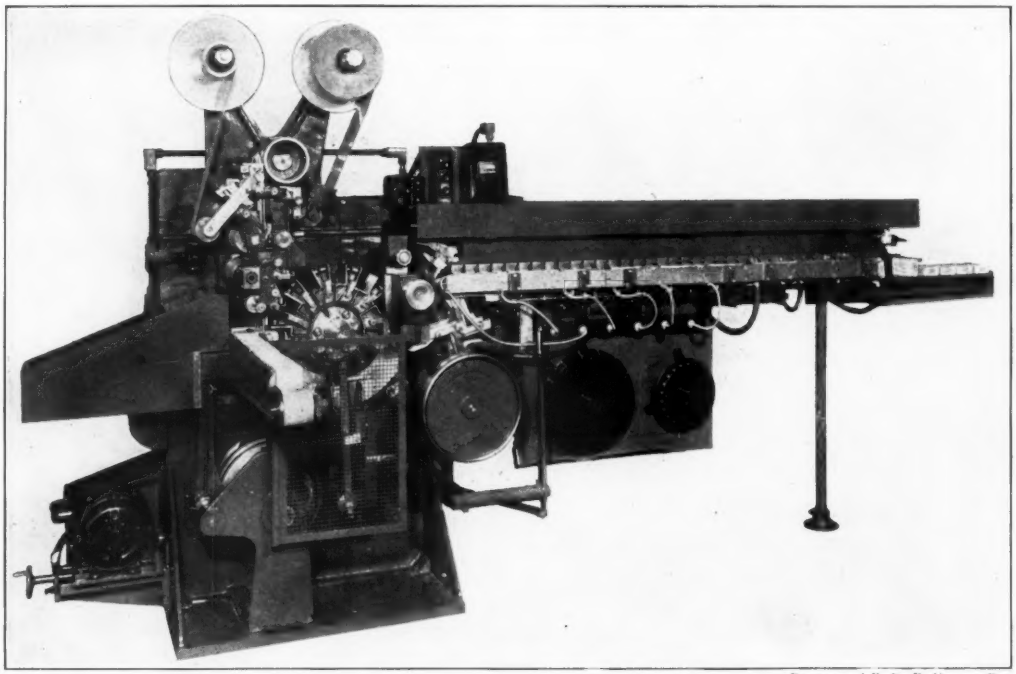
Courtesy of Standard-Knapp Corp.

Fig. 3—Details of a vertical labeler which is extensively provided with means for pressure grease lubrication.

contingent upon the extent to which automatic lubrication is provided for. Obviously, if oil is delivered by means of a drip feed oiler, wherein the principle is to supply just enough oil to maintain lubrication, increase in speed, unless the rate of drip of oil is increased, may result in impaired lubrication.

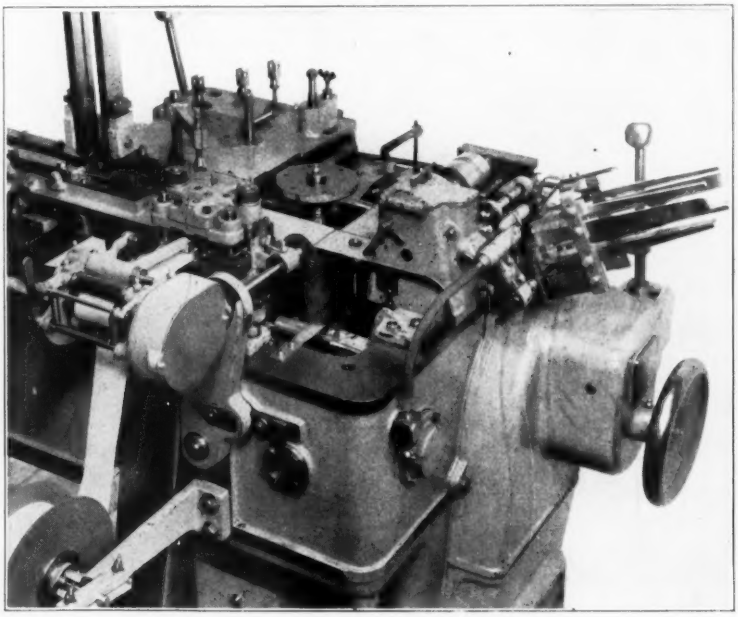
Where automatic lubrication, for example, of the force feed type, is involved, however, there will always be more oil delivered than is required to maintain lubrication. Flood lubrication will tend to materially resist the effects of pressure. This is admirably illustrated by the lubricating system of the average pressure-oiled steam turbine bearing. Here, although comparatively high speeds may be involved, and bearing pressures may be fairly high, if the oil is delivered under from 8 to 15 pounds pressure a product of as low a viscosity as 140 seconds Saybolt at 100 degrees Fahr., will adequately maintain lubrication and insure protection of the bearings.

There is a further advantage to flood lubrication, in that the excess oil passing through



Courtesy of F. B. Redington Co.

Fig. 4—A machine for wrapping soap. Note compactness of the assembly and extent to which the parts are guarded.

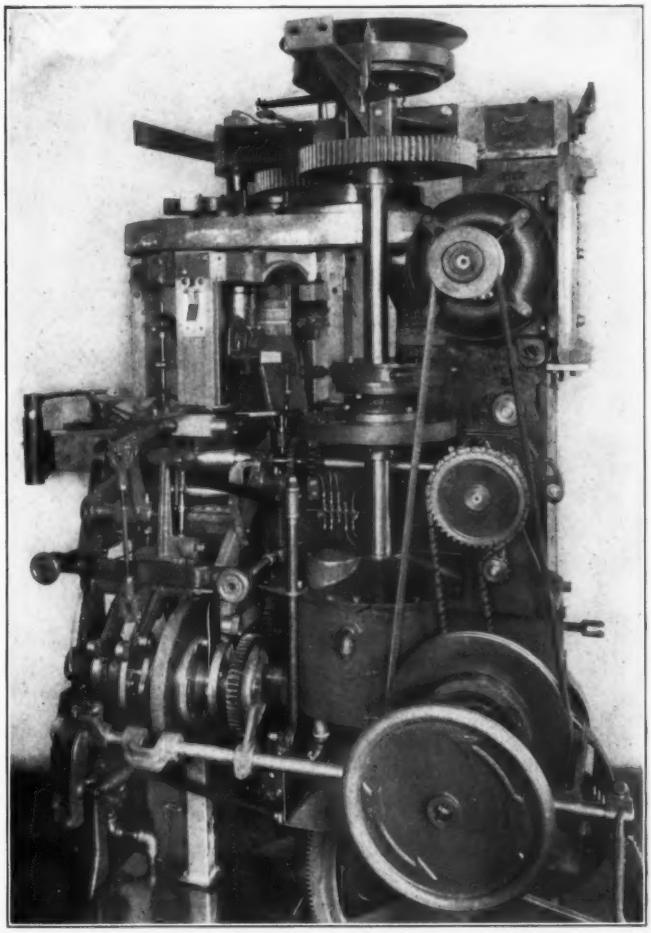


Courtesy of Package Machinery Co.

Fig. 5—In the wrapping machine for razor blades the driving mechanism is carefully housed and designed for partial immersion in oil. Further protection of other parts is maintained by an auxiliary oil circulating system.

the bearings will remove a certain amount of the heat developed during operation, or received from any external source. As a result, it may be said that speed leads to the development of a more positive lubricating film, due to the increased capillary action, or the extent to which the oil is drawn into the bearing. It also makes possible the use of a lighter product, which will oftentimes reduce the amount of power consumed as well as the amount of internal friction developed within the lubricant itself.

Wherever grease is to be used it is well to remember that such a product is more particularly adaptable to mechanisms where the cohesive ability of the lubricant will assist in its retention. If the bearing is properly designed to retain the lubricant, and a product chosen with a high degree of lubricating ability, lubrication will be assured for an extensive period of operation, with the necessity for only infrequent renewal.



Courtesy of Pneumatic Scale Corp., Ltd.

Fig. 6—Showing one of the junction boxes and part of the one-shot lubricating system on a bottom sealing machine.

It is important to remember that the average ball or roller bearing should not be completely filled with lubricant, for this may not only lead to channelling of the product but also to increased power consumption, due to the drag which may be imposed upon the rolling elements.

Wherever gears, chains or other motions are involved, however, speed must be studied from the viewpoint of the extent to which centrifugal force will be developed and the lubricant thrown from the moving parts. Here there is a greater relationship between speed and the adhesive characteristics of the lubricant. This will be especially true on exposed gears or chains. In an oil-tight gear or chain housing a comparatively fluid oil can be used, especially if it is automatically delivered to the parts and not merely carried to them by virtue of the dipping of the gear teeth or chain sprockets in the bath of lubricant.

Where gears and chains are not tightly housed, however, thought must be given to the adhesive charteristics as well as the viscosity of the lubricant. Straight mineral petroleum products are more adaptable to such installations than compounds such as greases.

Certain of these latter, of course, have comparatively high adhesive tendencies. On the other hand, they will be more expensive and not as durable for the service involved as straight mineral gear lubricants. Here again it is within the province of the lubricating engineer to study the installation and make his recommendation accordingly.

EFFECT OF PRESSURE

The important point to remember, in considering the relation of pressure to lubrication, is that if the viscosity or consistency of the lubricant is not sufficient to withstand any squeezing out action which may be developed due to the construction of the bearing, considerable damage because of lack of proper lubrication will probably follow. As a result, pressure is one of the salient factors which must be considered in the study of any lubricating problem and the preparation of a lubrication recommendation.

It is evident that under average conditions the greater the existing or operating pressure

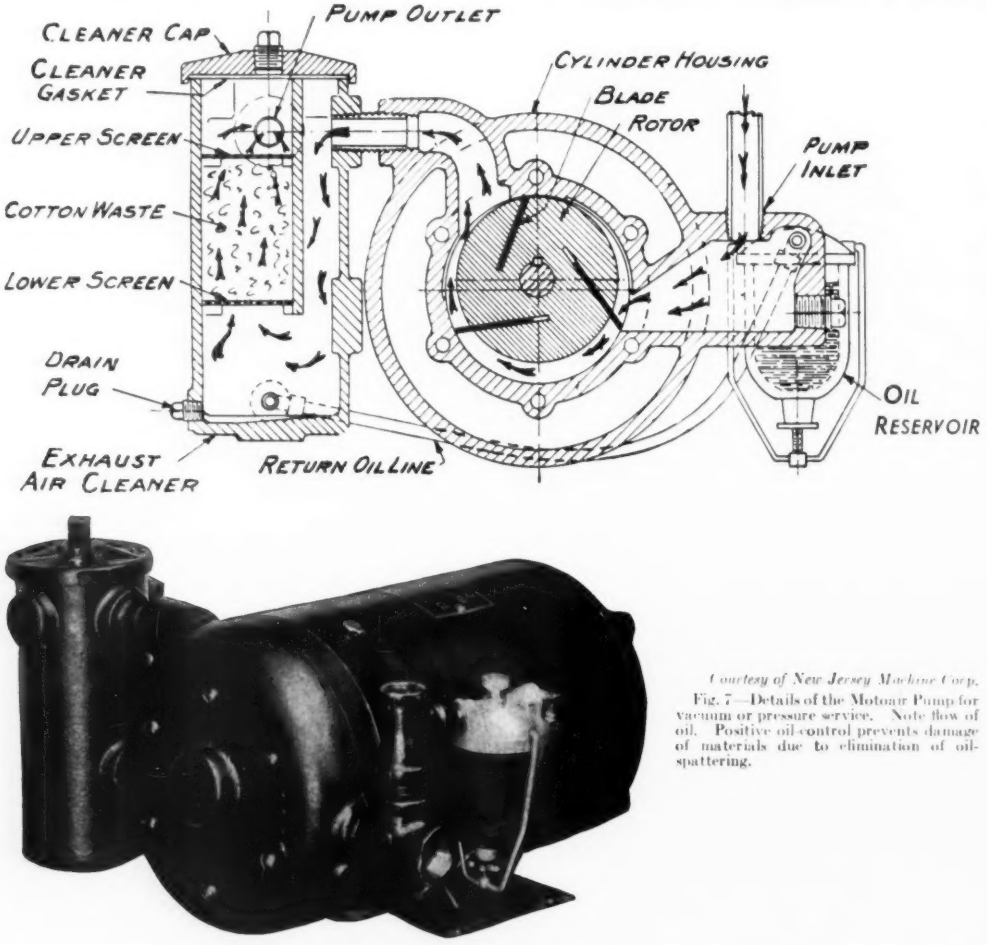
between any two wearing elements, the heavier or more viscous must be the lubricating film in order to prevent metal-to-metal contact. This holds true whether bearings, gear teeth or chain link connections are involved. The logical effect of pressure will be a tendency toward squeezing out of the lubricating film from between the wearing surfaces in question. In a plain bearing the essential solution to this problem will be proper grooving and adequate bearing area.

On the other hand, with certain types of wearing elements the danger of impaired lubrication due to pressure can be partially prevented by enclosed construction, and operating the parts in a bath or flood of lubricant. Relative to the development of such pressures, however, it must be remembered that the period of maximum intensity is comparatively brief. In other cases, pressure can be met with pressure, the lubricant being maintained within the clearance spaces under the prevailing pressure of some form of pumping device. This is, however, impracticable on open-ended bearings.

Conditions Involved

But, irrespective of the means of application, a certain degree of adhesiveness and sufficient viscosity must be prevailing characteristics of the lubricant itself. To make any other than generalized statements, as to the viscosity range, would be unwise. Too much will depend upon details of construction, operation and means of application. It will be far better to study these conditions in order that the severity of the duty may be realized. With such knowledge as a basis, and an understanding of what is actually involved when we speak of viscosity, etc., the problem of subsequently selecting either oils or greases to function effectively should be materially simplified.

It is practicable to use either oil or grease for the lubrication of many of the wearing elements. The ultimate factor will involve the type of lubricating equipment provided,



Courtesy of New Jersey Machine Corp.

Fig. 7—Details of the Motoair Pump for vacuum or pressure service. Note flow of oil. Positive oil-control prevents damage of materials due to elimination of oil-spattering.

and the operating conditions such as speed and bearing pressures and details of construction such as manner of grooving.

By virtue of the size, duty, and nature of the moving parts of the average packaging machine involving high pressures, it has been deemed advisable in many cases to provide for some form of positive, automatic lubrication. Greater convenience should thereby result, with frequently marked savings in labor due to reduction in the amount of attention necessary.

In virtually any piece of machinery where pressure may prevail it is important to remember that it is the "operating pressure" which must be considered. When idling, the pressure which may exist between the gear teeth or upon the bearings of certain of the shafting may not be abnormal. When idling there should, therefore, be no problem in the maintenance of lubrication on such equipment. During operation, however, the pressure developed will react back through practically all the moving elements of the machine. Not with the same intensity in every case, to be sure, for this will depend upon the size or relative importance of the parts involved. But, in general, such reactionary or back pressures will be considerably in excess of the idling pressures, and hence they will be a potential cause of lubricating difficulties.

Operating Pressure Most Important

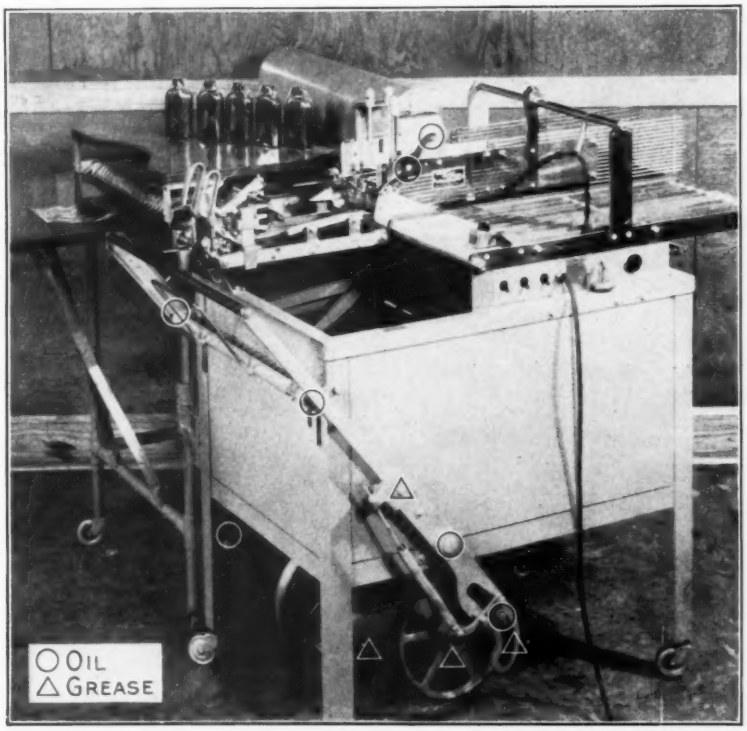
As a result, it is the operating pressure which must be taken into account. Lubricants must be used which will be of such body and adhesive ability as to effectively withstand being squeezed out from between gear teeth, chain link connections, or bearings and shafting. These characteristics in the lubricants must be considered from the viewpoint of maximum pressure involved.

Of course, on certain machinery this may result in abnormal internal friction within some lubricants when the machinery is idling but it is far more important to prevent metal-to-metal contact under high operating pressures and thereby preclude the development of abnormal wear, than to reduce power consumption during idling. This is especially true inasmuch as such machinery should idle as little as possible, in order to develop maximum efficiency.

TEMPERATURE

The influence which temperature will have upon a lubrication recommendation for any type of packaging machinery will depend upon the extent to which the operating temperatures may vary. As a general rule, this factor must be considered in deciding upon the manner of preparation of a grease, its melting point, or the viscosity of an oil, wherever conditions may be deemed to be in any way abnormal.

High temperature operation is worthy of special consideration. High temperature conditions will usually impose a greater duty upon a lubricant than any other phase of operation. In connection with this matter of temperature, it must be remembered that the inherent possibility of development of solid friction will always be present. Solid friction between any two surfaces in motion with respect to one another implies the presence of heat, which is invariably developed by friction. It is the function of lubrication to eliminate solid



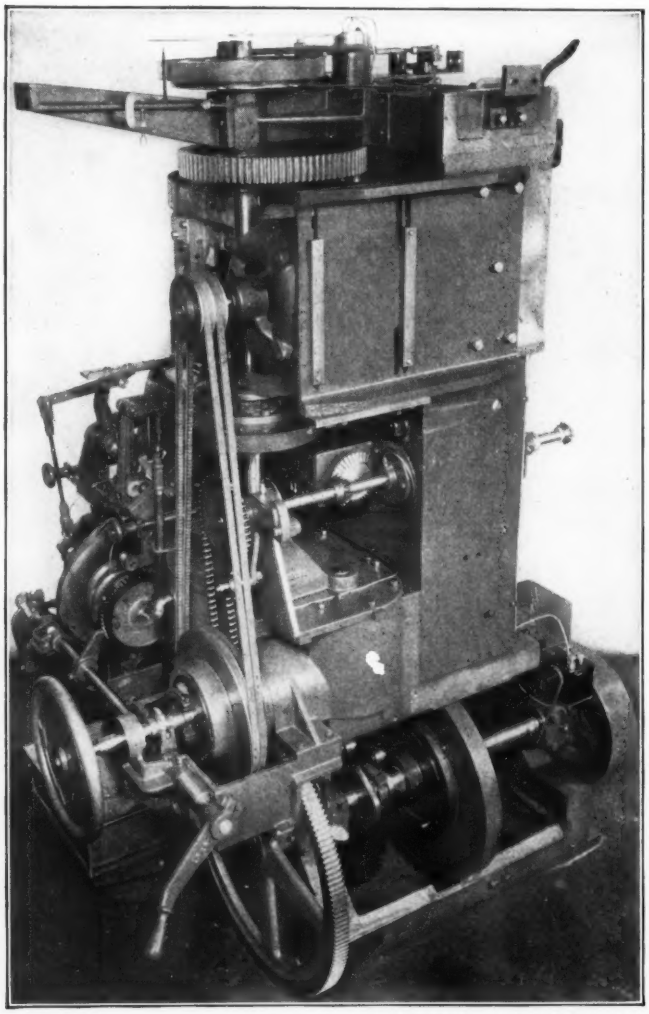
Courtesy of Amsco Packaging Machinery, Inc.

Fig. 8—Lubrication of this Miller wrapping and sealing unit is planned with due consideration of the possible effect of high temperatures both upon the parts to be lubricated and the lubricants used, hence the necessity for heat resisting products.

or metallic friction, supplementing it with fluid friction, which will normally be of far less intensity.

Where high operating temperatures may prevail the proper viscosity or body of a lubricant must be given all the more careful attention, for viscosity will vary inversely with temperature. In other words, the higher the operating temperature the greater will be the tendency for the body or viscosity of the lubricant to be reduced. If the original viscosity is not sufficiently high to allow for this reduction, the increased fluidity may lead to impairment of the lubricating film to such an extent as to actually cause metal-to-metal contact.

This will be especially apt to occur under comparatively high pressure. It is for this reason that the viscosity-temperature conversion chart should be studied in connection with the formulation of a lubrication recommendation for high temperature operation. By the use of such a chart one can readily determine the operating viscosity of any lubricating oil at the prevailing temperature of operation, knowing the viscosity at some two points such as 100 degrees and 210 degrees Fahr., according to the prevailing marketing specifications. Normally lubricating oils of a viscosity up to approximately 800 seconds Saybolt at 100 degrees Fahr., are specified at this particular temperature. The viscosity of heavier lubricants, however, is usually stated at 210 degrees Fahr.



Courtesy of Pneumatic Scale Corp., Ltd.

Fig. 9—Showing the drive for the automatic oil pump on a bottom sealing machine.

While the use of an oil of sufficient viscosity to meet the operating conditions will, of course, result in more effective lubrication, it will also prove of decided value in reducing the amount of power or energy required to move the working elements. In addition, any tendency towards the development of abnormal frictional heat will be reduced. All this will lead to improved lubrication, for it will enable the oil to function more dependably, maintaining the proper lubricating film under all conditions, by virtue of its viscosity or body.

The Importance of Viscosity

It has already been stated that viscosity varies inversely with the temperature. Under certain conditions this is an asset, for it may permit of one lubricant serving a number of points of varying external temperature, provided the size of the wearing elements and the pressure exerted are taken into account when the lubricant is originally selected.

On the other hand, the mistake should never be made of regarding the viscosity at say 100 degrees Fahr., as of sole importance, for an oil which might be of adequate viscosity at that temperature might be too light to meet an operating temperature range of say 150 degrees Fahr. As a result, there is a direct tie-up between power consumption, friction and temperature.

Low Temperature Operation

It is just as important to study the operating viscosity of an oil where low temperatures are

involved as when high temperatures are to be met. In case of low temperature operation, however, there will be less possibility of metal-to-metal contact between the wearing elements. Under such conditions we must be more concerned with the possibility of developing abnormal internal friction within the body of the lubricating film itself. This would, of course, lead to increased power consumption. If allowed to become abnormal it might even render the machine inoperative. There would also be the difficulty of delivering such a sluggish lubricant to the moving parts on starting. Should this latter prevail for any length of time, metal-to-metal contact might occur until the temperature of the machine is raised sufficiently to expedite ready flow of the lubricant.

LUBRICANT CONTAMINATION MUST BE PREVENTED

While packaging machinery is usually so designed that there will be but little possibility of contamination of either the product being packaged or the lubricant, it is well to be advised as to the detrimental effect a contaminated lubricant may have upon lubrication. Obviously it may defeat the objective regardless of how carefully the original selection may have been made.

The extent to which contamination may occur will depend upon the provisions for storage, the operating conditions to which the machines may be subjected and the nature of the materials being handled. It is important to discuss those preventive measures which will be helpful in keeping lubricants at their initial purity.

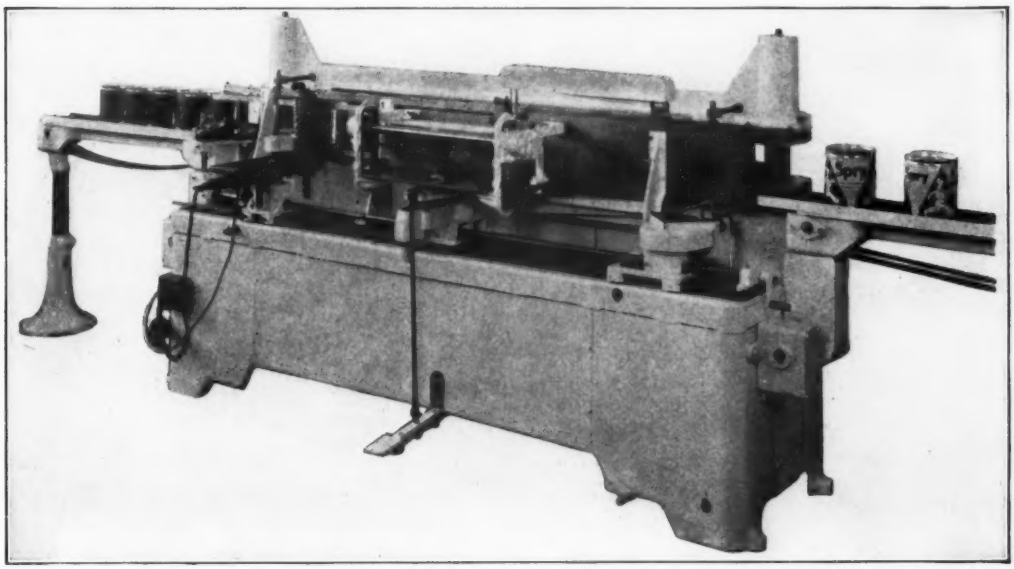
We have noted the extent to which operating conditions may affect the performance of a lubricant. Sometimes they may be very severe, but if the lubricant has been selected with respect to the extremes under which it may have to function, the problem is often more than half solved before the machine turns over.

Obviously, therefore, factors such as the viscosity, pour test or flash point should be of decided benefit in denoting how an oil will function at certain temperature extremes. At the same time, the probable body or relative degree of fluidity can be estimated.

They will not indicate, however, as to just how an oil will resist contamination when exposed to foreign matter. Where this latter is involved, the problem will be to study storage and handling conditions as well as the construction of wearing elements, to determine the most suitable type of guards, containers, or housings, and to establish rules for handling.

The extent to which an oil may become contaminated in storage will depend largely upon the location of the store-room and the nature of its construction. Every precaution must be taken to prevent dust or dirt contamination which might so easily occur if doors or windows are left open, or when they are poorly screened; air drafts may often cause circulation of considerable abrasive dust or dirt.

It will be only necessary to leave oil or grease in an open container for a short time under such conditions to result in absorption of



Courtesy of Standard-Knapp Corp.

Fig. 10—Operating view of a vertical labeler for large cans. Extensive means for pressure grease lubrication are provided.

whatever dust may settle on the surfaces.

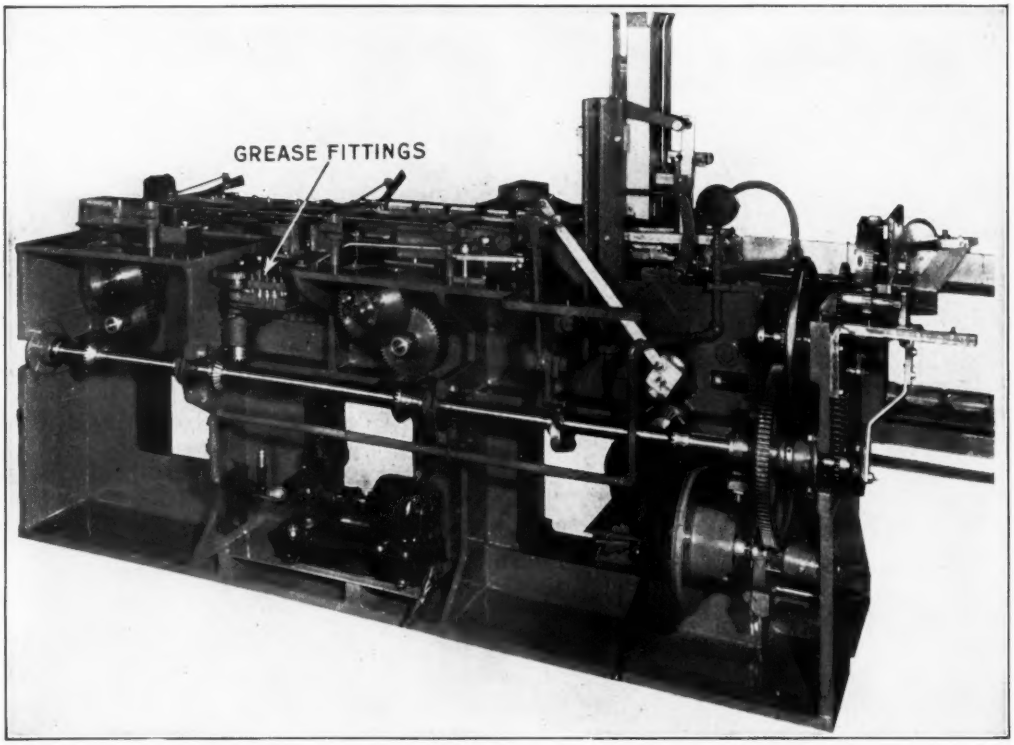
As virtually any type of dust is abrasive, lubricants which have been thus contaminated will very frequently tend to promote wear, by virtue of their dust content, rather than leading to its reduction by reason of their lubricating ability.

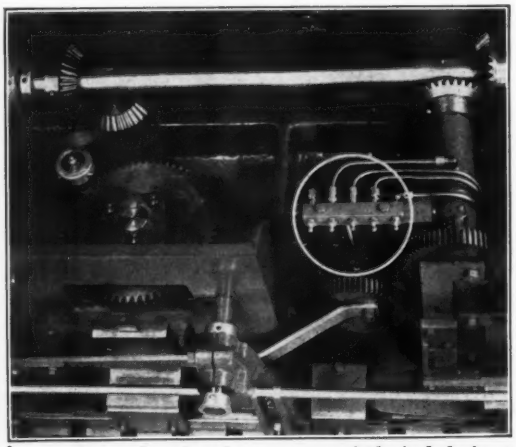
To prevent all this, lubricants should be stored in enclosed tanks or drums, with tightly fitting covers on all containers with removable heads.

Furthermore, lubricating oils should always be handled in clean distributing containers, and in just sufficient amounts to cover immediate requirements; in this way contamination at the point of distribution can be even more positively prevented.

Fluid oils can be more easily kept free from contamination during storage than greases. The latter will very frequently be so inert, and used in such comparatively small quantities, that storage in the shipping drums or barrels will prevail. With many steel containers the top is so constructed as to be replaceable. As a result it can be readily removed when a supply of lubricant is needed, and just as easily replaced to prevent the possible entry of dust or dirt.

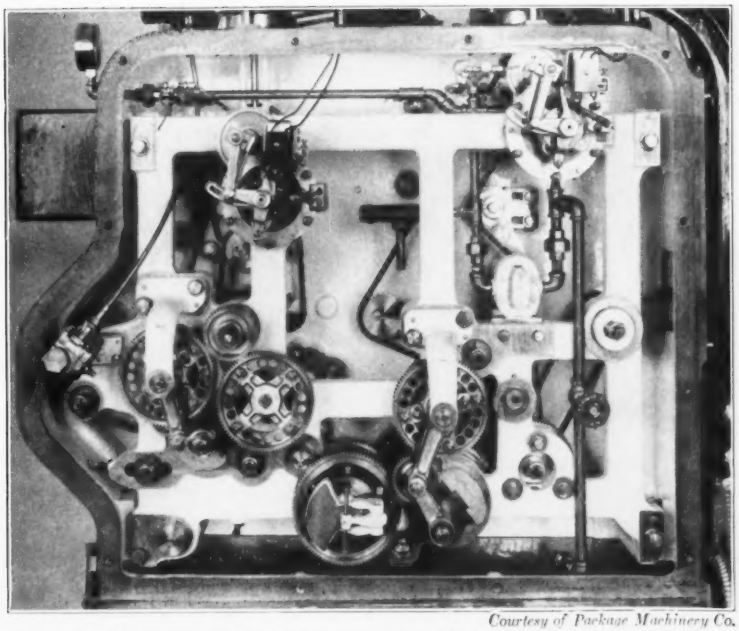
Where greases are involved, it must be remembered that the possibility of water contamination must always be guarded against. Certain greases, according to their nature and the purpose for which they are intended will contain more or less water. As a general rule, this is an accurately determined quantity. As a result, should any more gain entry, there will be possibility of some greases becoming decidedly altered from both a physical and chemical nature.





Courtesy of F. B. Redington Co.

Fig. 11—Showing location of certain of the grease fittings on a carton machine.



Courtesy of Package Machinery Co.

Fig. 12—Machinery for wrapping chewing gum operates at high speed. As the parts are built with close tolerances, positive lubrication is necessary. This view shows how oil is pumped from the bottom chamber through a pipe at the right hand side. Oil pressure is indicated by a gauge and is capable of valve control.

Handling of greases and other heavy or more or less inert lubricants must also be given careful consideration. In view of their consistency they must usually be scooped from the containers. This can only be done by hand. During such a procedure there will be considerable possibility of dirt gaining entry, especially if scoops or paddles have not been kept where they could not gather dust. Dirt may also fall from dirty clothing.

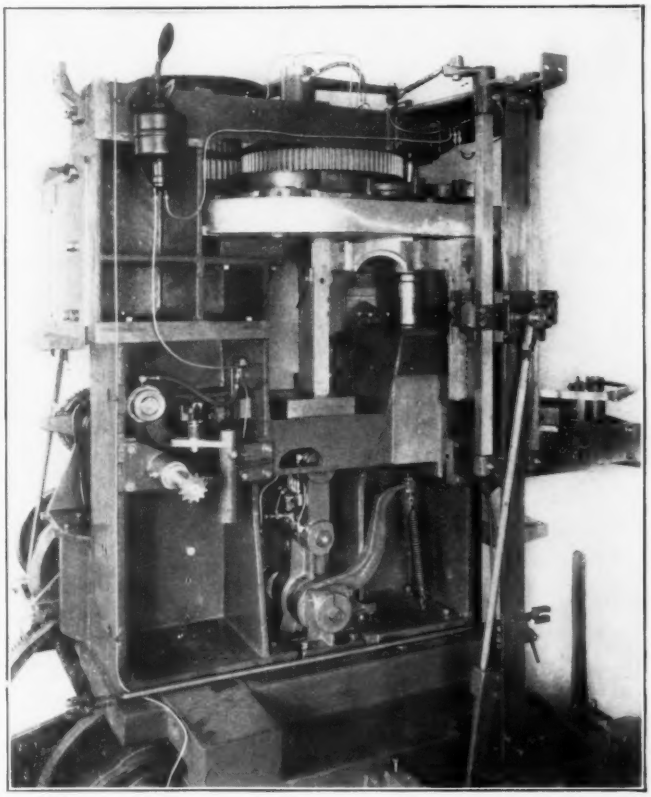
It is virtually impossible for one to keep clean around certain parts of many plants; as a result, all the employees should not have access to lubricant storage. It is far better to detail a certain part of plant personnel to work only in connection with lubricants and lubrication. They at least can keep cleaner than many of the others; in addition, the keeping of lubrication records, and maintenance of economy in issuing the various products can be practiced.

After lubricants have been issued to the several departments, protection against contamination must be observed by the individuals involved with their application.

Very often, where gears may run exposed, or only partly enclosed, it will seem to be fruitless to insist on undue care in application of lubricants. Gear teeth, however, can be protected by proper lubrication, and the less contaminated the lubricants, or the more dust-proof the casing, the more effectively will wear be reduced.

Bearing wear will oftentimes be more serious than wear on gear teeth. Furthermore, scoring or wear in a bearing will usually develop more rapidly, for it will normally not require as much abrasive matter in the lubricating film to damage a bearing as a gear tooth. For this reason bearings are usually constructed so as to more readily prevent entry of dust, dirt or scale.

With sleeve bearings of the grease lubricated type, the collar of grease at the



Courtesy of Pneumatic Scale Corp., Ltd.

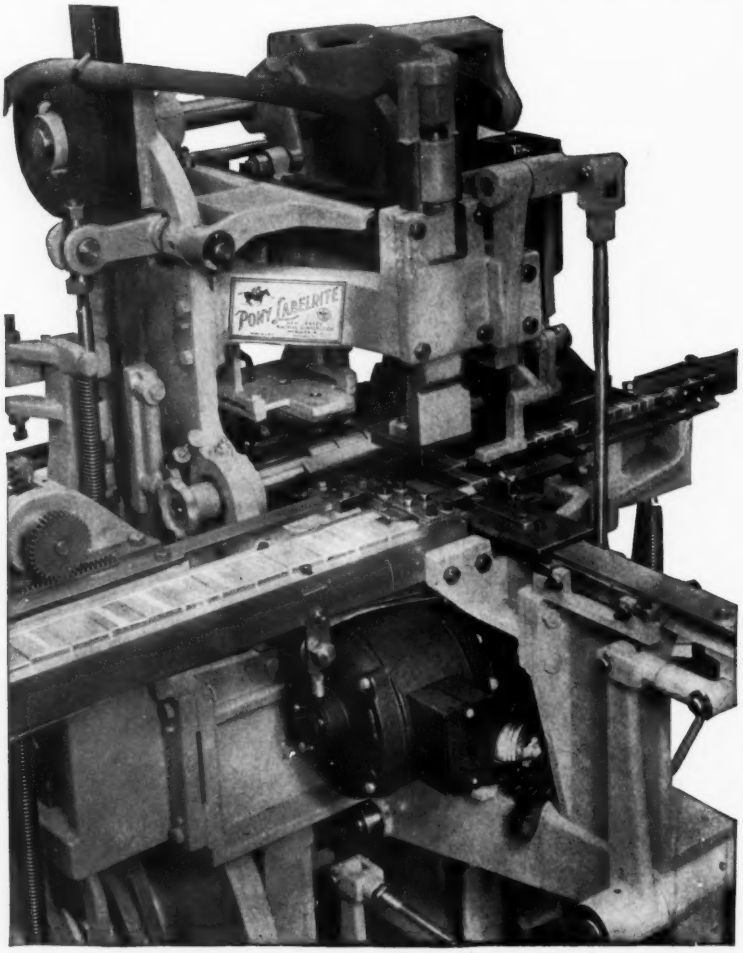
Fig. 13—Close up view of the hand oil pump which provides lubrication for some forty bearings on a bottom sealer.

exposed ends will often serve as a very good seal. How much abrasive foreign matter may gain entry will largely depend upon the condition of the lubricant when applied, and the means of delivery to the bearing.

Where automatic lubrication is involved, as for example, by use of the ring oiler, renewal of oil will only be necessary at infrequent intervals. During operation, the point of application should be sealed by a suitable dust-tight cap or plug. With the sight-feed oil cup, on the other hand, daily filling may be necessary, dependent upon the extent of operation and the capacity of the cup. This will require the keeping of an oil container at hand. If this latter is properly covered, or kept under the hood of an auxiliary storage tank, the purity of the contents can be preserved. If, however, it is allowed to remain open and exposed to dust or dirt, very soon the oil will become seriously contaminated. Continued handling of oils in this manner will result in decidedly impaired lubrication, abnormal wear and high repair costs.

PROTECTION OF RUBBER PARTS

The fact that rubber is used to a considerable extent in the make-up of certain types of rolls, belts and pads on some packaging machines, renders consideration of their protection quite important; even mandatory due to the present necessity for the conservation of rubber and prevention of its deterioration wherever possible. Contact with petroleum oils causes rubber deterioration. This is indicated by swelling. Less apparent but often more serious is the loss of tensile strength. Meanwhile deterioration due to aging must be expected; this is accelerated by exposure to direct sunlight and contact with oxygen from the air.



Courtesy of New Jersey Machine Corp.

Fig. 14—The Pony Labelrite machine with infeed conveyor and discharge chute showing arrangement of the working parts.

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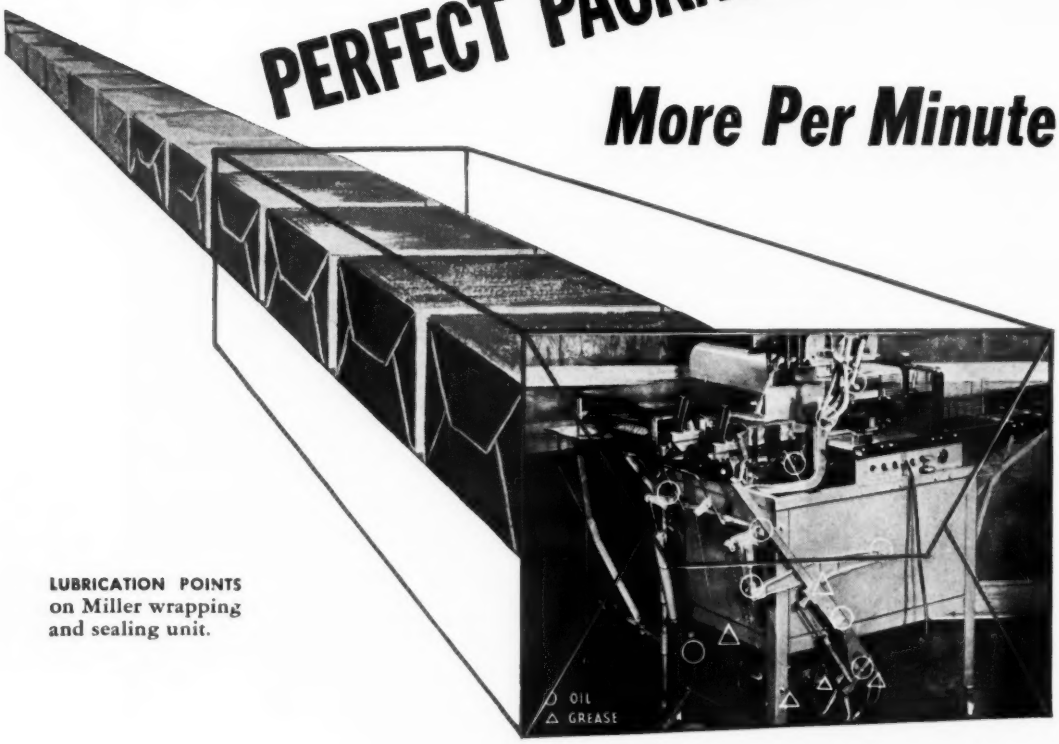
PERFECT PACKAGES

More Per Minute



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